Section 7. Consumption Adjustments for Calculating Expenditures

Expenditures developed in the EIA Combined State Energy Data System (CSEDS) and published in this report are calculated by using the CSEDS consumption estimates that are published in the *State Energy Data Report 1997, Consumption Estimates (SEDR),* September 1999. Expenditures are calculated by multiplying the price estimates by the consumption estimates, which have been adjusted to remove process fuel, intermediate petroleum products, and other consumption that has no direct fuel costs, i.e., hydroelectric, geothermal, wind, solar and photovoltaic energy sources, and some biomass energy.

Almost all aspects of energy production, processing, and distribution consume energy as an inherent part of those activities. CSEDS industrial and transportation sector consumption estimates include energy consumed in the process of providing energy to the end-use consumer and are called "process fuel." Familiar examples include energy sources used in drilling for oil and gas, transporting natural gas and petroleum by pipeline. Another "process fuel" is the energy used in generating and delivering electricity to end users. Energy products that are subsequently incorporated into another energy product for end-use consumption are called "intermediate products." Motor gasoline blending components are familiar examples of intermediate products that are consumed as part of the finished motor gasoline sold at service stations and other outlets.

Process fuel and intermediate products are not purchased by the end user and, therefore, do not have prices. Although the end user does not consume either process fuel or intermediate products directly, he does pay for them, because the cost to the processor or distributor is passed on to the end user in the price of the final end-user product. If their use was left in the consumption estimates and was assigned prices, the expenditures would be counted twice, first as paid by the "processor" (producer, processor, or transporter) and again as included in the price to the end user.

Some renewable energy sources are not purchased. These include hydroelectric, geothermal, wind, photovoltaic, and solar thermal energy. The consumption of these sources, which are measured in CSEDS as kilowatthours of electricity produced, are not included in *SEPER* expenditure estimates since there are no "fuel costs" involved. Wood and waste are sometimes purchased and sometimes obtained at no cost. Wood consumption estimates in the residential and commercial sectors and wood and waste in the industrial sector are adjusted in CSEDS to remove estimated quantities that were obtained at no cost.

To estimate energy expenditures in *SEPER*, the consumption of process fuel, intermediate products, and some of the renewable energy sources are subtracted from the end-use sector in which they are included in CSEDS, either the residential, commercial, industrial, or transportation sector, and there are no prices associated with them.

Process fuel consumption adjustments include:

1. Fuel (petroleum, natural gas, coal) and electricity consumed at refineries
2. Crude oil lease, plant, and pipeline fuel
3. Natural gas lease and plant fuel
4. Natural gas pipeline fuel
5. Electrical system energy losses (i.e., energy consumed in the generation, transmission, and distribution of electricity).

Intermediate product consumption adjustments include:

1. Aviation gasoline blending components
2. Motor gasoline blending components
3. Natural gasoline (1970 through 1983)

4. Pentanes plus (1984 forward)
5. Plant condensate (1970 through 1983)
6. Unfinished oils
7. Unfractionated stream (1970 through 1983).

Starting in 1984, natural gasoline (including isopentane) and plant condensate are reported together as the new product, pentanes plus, and the components of unfractionated stream are reported separately under liquefied petroleum gases.

Renewable energy consumption adjustments include:

1. Photovoltaic and solar thermal energy in the residential (including commercial) sector, the industrial sector, and at electric utilities
2. Geothermal energy in the residential, commercial, and industrial sectors
2. Electricity generated from hydropower, geothermal, and wind energy in the industrial sector and at electric utilities
3. Estimated portions of wood consumed in the residential and commercial sectors and wood and waste in the industrial sector that were obtained at no cost.

Table A51 shows the quantities of energy, by State, removed from CSEDS consumption to calculate expenditures for 1997. State estimates for 1970 through 1997 are available on the CSEDS Internet data files.

Table A52 shows the adjustments made to CSEDS national consumption estimates for 1970 through 1997 to derive the net consumption data used to calculate expenditures.

Adjustment Procedures

Refinery Fuel. Refinery fuel consumption of distillate fuel, residual fuel, liquefied petroleum gases, petroleum coke, still gas, natural gas, coal, and electricity is individually estimated for each source and subtracted from each State's CSEDS industrial sector total.

Because crude oil consumption is not an individual fuel in CSEDS for 1970 through 1980, the small amounts of crude oil that were used at refineries during those years were allocated to residual and distillate fuels consumed at refineries. The allocation from crude oil refinery use to residual and distillate fuels refinery use was made according to each fuel's share of the total crude oil used directly (including losses) as residual and distillate fuels from the *Petroleum Supply Annual, Volume 1,* of each year, Table 2).

Refinery consumption of still gas, excluding still gas consumed as petrochemical feedstocks, is subtracted from the CSEDS industrial sector total for 1970 through 1985. Beginning in 1986, EIA data series no longer report refinery fuel and feedstock use separately, and all industrial still gas consumption is removed.

Refinery fuel consumption data are available in the data sources by State or group of States (1970 through 1980) and by Petroleum Administration for Defense District (PADD) (1981 forward). Where State-level consumption data are not available, the State-level estimates are derived by allocating the district's or group's total consumption to the individual States within the district or group that had operating refineries in a given year. Individual fuels are allocated to the refining States according to each State's share of the refining States' subtotal of industrial sector fuel consumption during the year. In some instances, estimated refinery fuel consumption exceeds the CSEDS estimate for total industrial consumption of a fuel within a State. When this occurs, the excess refinery fuel consumption is reallocated as shown in Table A53.

Intermediate Products. Aviation gasoline blending components, motor gasoline blending components, natural gasoline (1970 through 1983), pentanes plus (1984 forward), plant condensate (1970 through 1983), unfinished oils, and unfractionated stream (1970 through 1983) are used at refineries and blending plants to make end-use petroleum products, particularly motor gasoline. Accordingly, consumption of these products is completely removed.

Residential and Commercial Geothermal, Solar, and Wood. There are no fuel costs for geothermal, photovoltaic, and solar thermal energy sources; therefore, all consumption is removed from the expenditure calculations. Some residential and commercial wood is purchased and some acquired at no cost. Based on responses to the Form EIA-457, "1980 Residential Energy Consumption Survey," Census division percentages of wood purchased were developed and applied to each State's residential and commercial wood consumption in the divisions in 1970 through 1989. Based on responses to the Form EIA-457, "1993

Table A51. Estimates of Energy Consumed as Process Fuel, Intermediate Products, and Uncosted Renewables, 1997
(Billion Btu)

State	Refinery Use							
	Distillate	Residual	LPG	Other Petroleum [a]	Natural Gas	Coal	Electricity [b]	Total
AK	235	492	7	24,647	27,518	—	109	53,009
AL	43	1,417	7	16,084	27,477	—	7,935	52,964
AR	39	50	7	8,045	19,650	—	3,803	31,593
AZ	—	—	—	—	—	—	—	—
CA	921	361	2,341	227,697	65,903	—	8,955	306,178
CO	—	21	35	9,952	7,351	—	1,651	19,010
CT	—	—	—	1,524	—	—	—	1,524
DC	—	—	—	—	—	—	—	—
DE	32	1,702	36	20,496	721	50	286	23,323
FL	—	—	—	2,908	—	—	—	2,908
GA	347	4,282	147	8,086	8,446	590	2,592	24,490
HI	41	2,998	480	14,851	28	—	557	18,955
IA	—	—	—	324	—	—	—	324
ID	—	—	—	—	—	—	—	—
IL	97	2,167	1,568	135,223	13,703	45	3,769	156,571
IN	60	3,440	210	59,640	12,408	60	3,873	79,691
KS	63	536	691	33,508	6,722	2	833	42,354
KY	68	528	295	40,752	4,353	28	3,611	49,635
LA	124	2,394	330	340,434	175,001	—	7,905	526,188
MA	—	—	—	1,936	—	—	—	1,936
MD	—	—	—	2,057	—	—	—	2,057
ME	—	—	—	139	—	—	—	139
MI	48	1,327	458	26,037	15,402	30	3,151	46,452
MN	76	1,662	398	38,442	4,614	14	2,465	47,671
MO	—	—	—	2,649	—	—	—	2,649
MS	46	73	31	36,554	11,336	—	3,557	51,596
MT	—	1,032	24	18,481	1,524	—	727	21,789
NC	—	—	—	4,069	—	—	—	4,069
ND	31	568	78	7,749	1,292	43	185	9,946
NE	—	—	—	—	—	—	—	—
NH	—	—	—	128	—	—	—	128
NJ	127	1,898	99	99,612	9,858	3	1,020	112,618
NM	21	373	5	12,152	13,471	—	1,505	27,527
NV	266	731	131	610	2,368	—	1,449	5,555
NY	—	—	—	7,116	—	—	—	7,116
OH	68	3,793	640	69,927	14,877	48	6,571	95,924
OK	41	829	172	48,119	12,235	8	1,139	62,543
OR	—	—	—	298	—	—	—	298
PA	298	3,117	114	90,677	11,714	1,275	3,661	110,855
RI	—	—	—	—	—	—	—	—
SC	—	—	—	5,710	—	—	—	5,710
SD	—	—	—	—	—	—	—	—
TN	52	346	73	22,546	6,047	46	2,464	31,573
TX	216	4,364	1,970	637,184	304,402	—	24,432	972,567
UT	—	889	55	18,606	5,036	—	1,191	25,777
VA	356	3,377	79	11,544	4,254	717	1,469	21,796
VT	—	—	—	—	—	—	—	—
WA	226	1,075	654	63,002	9,277	—	4,526	78,761
WI	55	2,948	200	5,895	6,645	21	2,233	17,997
WV	202	324	88	14,378	3,247	474	853	19,566
WY	—	26	27	16,310	5,004	—	1,156	22,522
US	4,200	49,139	11,452	2,206,096	811,883	3,453	109,631	3,195,854

Table A51. Estimates of Energy Consumed as Process Fuel, Intermediate Products, and Uncosted Renewables, 1997 (Continued)
(Billion Btu)

State	Residential		Commercial		Industrial					Transportation	Electrical System Energy Losses	Total
	Geothermal and Solar [c]	Wood	Geothermal	Wood	Crude Oil Lease, Plant, and Pipeline Fuel	Natural Gas Lease and Plant Fuel	Hydro-electricity	Geothermal Wind and Solar	Wood and Waste	Natural Gas Pipeline Fuel		
AK	16	892	20	86	—	271,284	—	16	1,152	4,938	40,081	371,494
AL	156	6,094	—	591	—	9,880	2,431	—	98,035	21,544	528,282	719,977
AR	1,279	2,329	4	226	—	6,950	46	—	42,549	11,748	261,169	357,892
AZ	3,781	3,961	2	384	—	52	—	227	9,274	19,016	385,869	422,566
CA	19,205	27,306	528	2,649	4,623	75,499	27,218	196,758	53,850	22,892	1,614,709	2,351,417
CO	292	3,472	179	337	—	29,949	1,415	156	3,930	12,523	269,755	341,018
CT	183	3,425	—	332	—	—	683	—	8,553	2,562	201,467	218,730
DC	—	824	—	80	—	—	—	—	—	251	71,616	72,771
DE	101	917	—	89	—	—	—	—	1,466	13	71,727	97,636
FL	30,955	4,937	385	479	—	2,566	8,149	—	32,757	5,950	1,240,324	1,329,410
GA	231	8,423	2	817	—	—	371	—	55,567	8,189	724,533	822,622
HI	1,176	—	—	—	—	—	1,005	5,469	6,324	—	35,046	67,976
IA	96	3,443	161	334	—	—	106	—	43,138	11,412	256,141	315,157
ID	106	1,000	161	97	—	—	10,704	258	11,213	5,347	150,471	179,357
IL	500	9,814	—	952	—	88	903	—	42,534	14,825	896,004	1,122,191
IN	730	4,976	161	483	—	12	—	—	24,223	10,891	631,684	752,850
KS	65	3,164	167	307	—	46,932	145	—	5,141	39,181	228,662	366,118
KY	334	5,518	161	535	—	2,580	—	—	10,806	24,003	544,449	638,021
LA	237	3,926	161	381	—	258,137	15,340	—	68,478	81,140	537,719	1,491,707
MA	209	6,395	163	620	—	—	3,585	—	28,311	2,404	337,710	381,332
MD	150	5,958	—	578	—	3	—	—	16,528	3,229	398,685	427,188
ME	113	1,556	—	151	—	—	19,655	—	88,812	—	84,740	195,165
MI	1,066	8,420	161	817	—	12,552	1,449	—	56,940	24,747	690,101	842,705
MN	560	5,649	—	548	—	—	3,500	562	46,030	19,865	394,503	518,888
MO	210	6,713	—	651	—	—	—	—	5,555	7,531	465,349	488,659
MS	15	3,657	164	355	—	3,773	—	—	39,731	46,472	284,065	429,829
MT	38	833	54	81	—	2,347	604	35	5,580	3,542	84,446	119,348
NC	329	8,967	—	870	—	—	18,403	—	47,289	7,526	772,718	860,171
ND	97	832	86	81	—	9,001	—	—	27	4,981	58,689	83,738
NE	77	2,004	186	194	—	45	—	—	393	4,076	160,016	166,992
NH	37	1,321	—	128	—	—	4,833	—	15,045	24	64,349	85,866
NJ	579	4,761	—	462	—	—	462	—	13,429	3,526	467,068	602,904
NM	551	1,496	41	145	—	65,848	—	131	1,116	63,232	124,201	284,290
NV	379	1,358	409	132	—	9	203	33,279	127	673	171,614	213,737
NY	543	17,180	179	1,666	—	798	16,983	—	56,347	7,671	934,888	1,043,371
OH	533	9,538	161	925	—	1,255	—	—	57,036	20,330	1,123,173	1,308,875
OK	83	3,219	—	312	—	81,902	—	—	7,467	26,287	314,989	496,801
OR	668	4,781	250	464	—	—	4,421	81	49,958	13,084	337,309	411,313
PA	755	7,694	164	746	—	2,355	4,896	—	56,013	40,544	906,112	1,130,134
RI	38	1,076	—	104	—	—	78	—	439	856	47,428	50,019
SC	136	4,530	—	439	—	—	587	—	41,935	3,032	485,629	541,997
SD	53	891	250	86	—	228	—	9	1,030	2,962	55,076	60,587
TN	97	7,468	—	724	—	46	10,047	—	45,669	23,258	615,886	734,770
TX	749	6,980	177	677	—	310,803	6,358	844	43,385	84,564	2,031,554	3,458,658
UT	104	1,432	151	139	—	25,659	141	303	1,176	3,059	144,379	202,321
VA	279	7,897	164	766	—	1,388	1,332	—	22,899	7,711	619,452	683,684
VT	20	716	—	69	—	—	1,869	—	6,310	9	37,641	46,635
WA	377	8,225	223	798	—	—	5,666	—	83,148	9,242	625,731	812,173
WI	336	4,543	—	441	—	—	3,091	—	147,491	4,595	425,820	604,313
WV	42	2,360	—	229	—	7,701	7,932	—	5,232	34,519	185,985	263,566
WY	2	466	622	45	—	21,056	—	27	1,316	11,183	83,516	140,754
US	68,665	243,336	5,700	23,603	4,623	1,250,701	184,611	238,156	1,510,755	781,160	22,222,509	29,729,693

[a] In this table, "other petroleum" consists of: still gas and petroleum coke consumed as process fuel; and aviation gasoline blending components, motor gasoline blending components, pentanes plus, and unfinished oils used as intermediate products.
[b] Electricity is converted at the rate of 3,412 Btu per kilowatthour.
[c] Includes small amounts of solar energy consumed by the commercial sector that cannot be separately identified.
—No consumption.
Source: State Energy Price and Expenditure Data System 1997.

Table A52. Energy Consumption Adjustments, 1970 Through 1997
(Trillion Btu)

Year	Total (Gross) Consumption	Adjustments													Net Consumption
		Residential		Commercial		Industrial						Transportation	Electrical System Energy Losses	Total	
		Geothermal and Solar [a]	Wood	Geothermal	Wood	Refinery Use	Crude Oil Lease, Plant, and Pipeline Fuel	Natural Gas Lease and Plant Fuel	Hydro-electricity	Geothermal, Wind, and Solar	Wood and Waste	Natural Gas Pipeline Fuel			
1970	67,761	—	298	—	6	2,714	—	1,442	34	—	788	740	11,517	17,539	50,222
1971	69,218	—	284	—	5	2,694	—	1,456	34	—	804	761	12,127	18,165	51,053
1972	72,775	—	282	—	5	2,847	—	1,497	34	—	859	786	13,110	19,420	53,355
1973	75,877	—	263	—	5	3,010	—	1,539	35	—	900	745	13,999	20,495	55,382
1974	74,065	—	275	—	5	2,983	—	1,520	33	—	896	684	14,198	20,595	53,470
1975	72,066	—	316	—	6	2,884	—	1,434	32	—	822	595	14,384	20,473	51,593
1976	76,103	—	357	—	7	2,907	—	1,679	33	—	942	559	15,255	21,739	54,364
1977	78,151	—	402	—	8	3,008	—	1,706	33	—	989	544	16,060	22,750	55,401
1978	80,192	—	462	—	9	2,939	—	1,694	32	—	1,081	541	16,850	23,608	56,584
1979	81,067	—	543	—	10	3,078	—	1,534	34	—	1,086	613	17,063	23,960	57,107
1980	78,465	—	632	—	15	3,052	—	1,058	33	—	1,283	650	17,387	24,110	54,355
1981	76,601	—	640	—	15	2,204	—	959	33	—	1,354	660	17,464	23,329	53,272
1982	73,400	—	690	—	17	2,089	—	1,144	33	—	1,311	614	17,100	22,996	50,404
1983	73,279	—	681	—	16	2,121	140	1,010	33	—	1,480	505	17,583	23,571	49,708
1984	76,912	—	690	—	16	2,254	135	1,113	33	—	1,510	545	18,157	24,454	52,458
1985	76,827	—	673	—	—	2,046	128	1,001	33	—	1,503	521	18,631	24,535	52,292
1986	77,031	—	655	—	—	2,285	103	954	33	—	1,478	501	18,593	24,603	52,428
1987	79,550	—	633	—	—	2,485	72	1,194	33	—	1,472	538	19,156	25,584	53,965
1988	83,087	—	658	—	—	2,696	85	1,134	33	—	1,531	633	19,887	26,657	56,430
1989	84,518	52	682	3	—	2,710	59	1,103	74	140	1,363	650	20,294	27,130	57,388
1990	83,990	54	337	3	—	2,803	51	1,269	85	185	1,379	682	20,246	27,093	56,897
1991	84,004	56	355	3	—	2,668	39	1,164	85	206	1,352	622	20,506	27,055	56,949
1992	85,181	58	374	3	—	2,954	27	1,209	98	219	1,424	608	20,122	27,096	58,085
1993	87,028	60	308	3	25	2,878	21	1,199	119	247	1,430	643	20,607	27,540	59,488
1994	88,832	61	302	4	25	2,991	19	1,153	136	259	1,444	706	20,869	27,970	60,862
1995	90,676	64	335	5	25	2,915	15	1,253	152	252	1,419	723	21,394	28,551	62,126
1996	93,584	66	334	5	28	3,203	14	1,280	171	261	1,480	734	21,972	29,549	64,035
1997	94,064	69	243	6	24	3,196	5	1,251	185	238	1,511	781	22,223	29,730	64,334

[a] Includes small amounts of solar energy consumed by the commercial sector that cannot be separately identified.

—No consumption.

Note: Totals may not equal sum of components due to independent rounding.

Sources: **Total (Gross) Consumption—**EIA, *State Energy Data Report 1997, Consumption Estimates, (SEDR)* DOE/EIA-0214(97) (Washington, DC, September,1999), p. 21, column titled, "Total."
Residential Geothermal and Solar—EIA, *SEDR,* p. 22, columns titled "Geothermal" and "Solar."
Residential Wood—Combined State Energy Data System 1997 (CSEDS).
Commercial Geothermal—EIA, *SEDR,* p. 23, column titled "Geothermal."
Commercial Wood—CSEDS.
Refinery Use—CSEDS.
Crude Oil Lease, Plant, and Pipeline Fuel—CSEDS.
Natural Gas Lease and Plant Fuel—CSEDS.
Hydroelectricity—EIA, *SEDR,* p. 24, column titled, "Hydroelectric Power."
Geothermal, Wind, and Solar—EIA, *SEDR,* p. 24, column titled, "Other."
Wood and Waste—CSEDS.
Natural Gas Pipeline Fuel—CSEDS.
Electrical System Energy Losses—EIA, *SEDR,* Tables 12-15, pp. 22-25, sum of four end-use sectors' column titled, "Electrical System Energy Losses."
Total Adjustments—CSEDS.
Net Consumption—CSEDS.

Table A53. Reallocations of Excess Refinery Fuel Consumption

Year	Fuel	Thousand Barrels	Excess in:	Reallocated to:
1971	Residual Fuel	294	Kansas	Oklahoma
1973	Residual Fuel	45	Group 4: Kentucky, Tennessee	Illinois
1979	LPG	173	Montana	Wyoming
1985	Residual Fuel	212	PADD IV	PADD V
1986	Residual Fuel	403	PADD IV	PADD V
1987	Residual Fuel	497	PADD IV	PADD V
1988	Residual Fuel	305	PADD IV	PADD V
1989	Residual Fuel	381	PADD IV	PADD V
1990	Residual Fuel	332	PADD IV	PADD V
1991	Residual Fuel	374	PADD IV	PADD V
1992	Residual Fuel	355	PADD IV	PADD V
1996	Residual Fuel	179	PADD IV	PADD V
1997	Residual Fuel	92	PADD IV	PADD V

Source: EIA calculations based on data from the *State Energy Data Report* and the *Petroleum Supply Annual*.

Residential Energy Consumption Survey," Census region percentages were developed and applied the State residential and commercial wood consumption in 1990 through 1997.

Crude Oil Lease, Plant, and Pipeline Fuel. Industrial crude oil is assumed to be used as lease, plant, and pipeline fuel. Because these are process fuel uses, this crude oil is removed from CSEDS industrial sector consumption.

Natural Gas Lease and Plant Fuel. Natural gas consumed as lease and plant fuel is process fuel and is subtracted from CSEDS industrial sector natural gas totals by State and year.

Industrial Hydroelectricity, Geothermal, Wind, Photovoltaic and Solar Thermal Energy. Electricity generated by industries from hydropower and geothermal, wind, photovoltaic, and solar thermal energy has no fuel cost. Operation and maintenance costs associated with these energy sources are included indirectly in the prices of the industries' products. Therefore, CSEDS industrial use of these renewable sources are removed from the expenditure calculations.

Industrial Wood and Waste. The cost of wood and waste products used for energy vary widely from more expensive woods to free industrial waste products. Industrial consumption is broken into two segments, manufacturing industries and nonutility power producers in order to estimate quantities received at no cost. Adjustments to manufacturing consumption in 1980 forward are based on information gathered on the Form EIA-846, "1991 Manufacturing Energy Survey." These percentages are applied to CSEDS industrial consumption of wood and waste by each consuming category (manufacturing SIC groups) for each State in each year to estimate the purchased consumption used to calculate expenditures. Adjustments to industrial wood and waste consumption in 1970 through 1979 are based on the 1980 average ratios for each State. Estimates of wood and waste purchased by nonutility power producers for 1989 forward are developed from data reported by electric utilities on several annual EIA electric power plant data collection forms. State purchased industrial wood and waste consumption quantities are the sum of the estimated manufacturing and nonutility power producers' consumption for each year.

Natural Gas Pipeline Fuel. Most of the natural gas consumed in the transportation sector of CSEDS is used to power pipelines. As such, it is a process fuel and is subtracted from CSEDS consumption in order to calculate expenditures.

Electrical System Energy Losses. The amount of energy lost during generation, transmission, and distribution of electricity (including plant use and unaccounted for electrical energy) is process fuel and is subtracted from sectoral energy consumption estimates used in *SEPER*. The energy losses are "paid for" when residential, commercial, industrial, and transportation sector consumers buy the electricity produced at electric utilities.

Data Sources

Capacity of Petroleum Refineries. 1982 forward: Energy Information Administration, *Petroleum Supply Annual, Volume 1*, tables titled "Number and Capacity of Operable Petroleum Refineries," columns titled, "Crude Capacity, Barrels per Calendar Day, Operating" (1982–1985),

and "Atmospheric Crude Oil Distillation Capacity, Barrels per Calendar Day, Operating" (1986 forward).

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